



University of Washington Research with SeaKleen®

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Washington Sea Grant Program



Presentation Topics

Introduction of UW Personnel

Ballast Water Research Projects at UW

SeaKleen® Mesocosm Experiments

SeaKleen® Microcosm Experiments

SeaKleen® Shipboard Experiments

UW Personnel

Russ Herwig (herwig@u.washington.edu)

Research Associate Professor

Marine Ballast Water Specialist - WA Sea Grant
Program

Environmental Microbiology/ Microbial Ecology

Jeff Cordell (jcordell@u.washington.edu)

Research Biologist

Zooplankton Ecology

UW Personnel

Nissa Ferm

Research Scientist

Zooplankton Ecology

Jake Perrins

Research Scientist and Graduate Student

Microbiology and Aquatic/Disinfectant Chemistry

Jaime Grocock

Research Scientist

Microbiology

Ballast Water Research Projects at UW

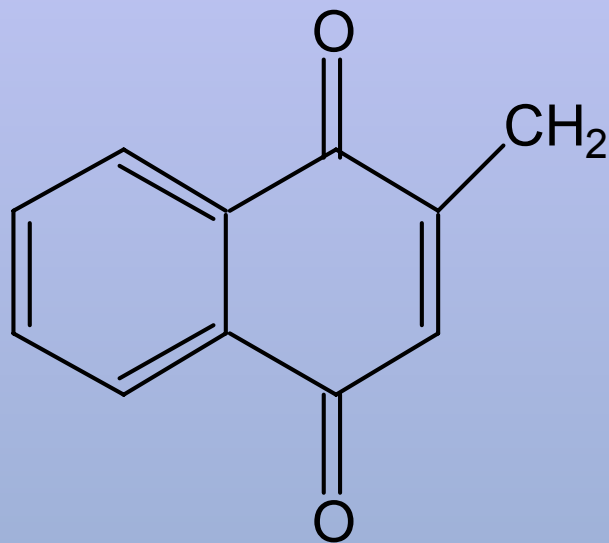
Puget Sound Ship Sampling

Efficacy of an Prototype Shipboard Ozone
Treatment System

Laboratory Mesocosm Experiments with
Potential Treatment Systems

Ozone, Ultraviolet (UV) Light, SeaKleen®,
(Filtration/Chlorination)

UW Research with SeaKleen®



Menadione, Vitamin K₃

Experiments at Two Scales

Mesocosm experiments

75 gallons (280 liters) per replicate

Microcosm experiments

3 liters per replicate

Experimental Design

Water: Puget Sound

Organisms: Puget Sound

Microorganisms

Mesoplankton, plankton > 73 or 110 μm

SeaKleen®: 1 and 2 ppm active
ingredient, lower concentrations in
future experiments

Replication: 4 containers per treatment

Controls: Organisms without SeaKleen®

December 2003 Mesocosm Experiments

Location: USGS Marrowstone Marine Field Station, Nordland, WA

Puget Sound Water: approx 8°C

Amend water with additional mesoplankton

Enumeration of:

- Culturable bacteria

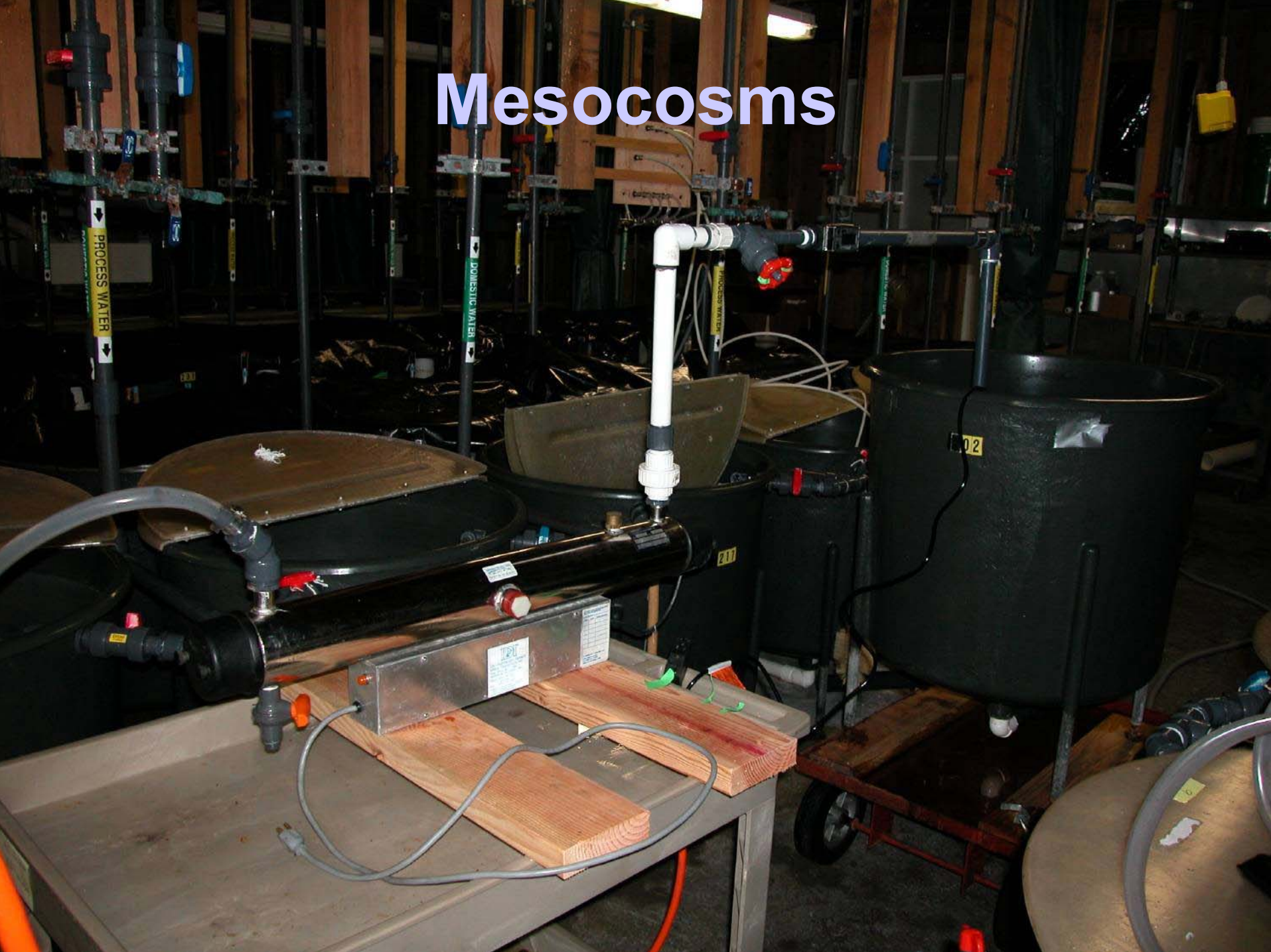
- Live/dead/moribund zooplankton

Mesocosm Experiments



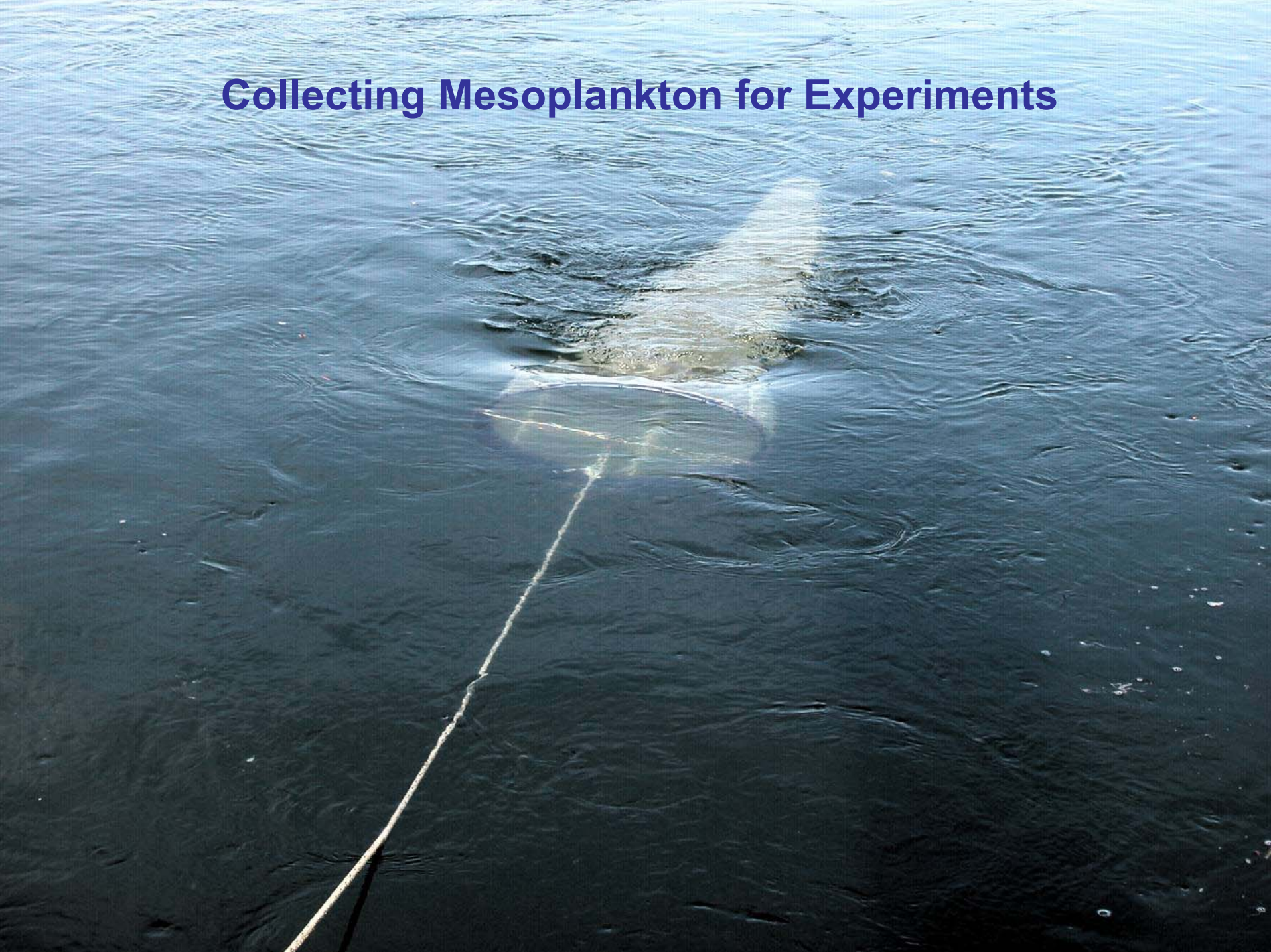
USGS Marine Field Station, Puget Sound

Mesocosms





Collecting Mesoplankton for Experiments



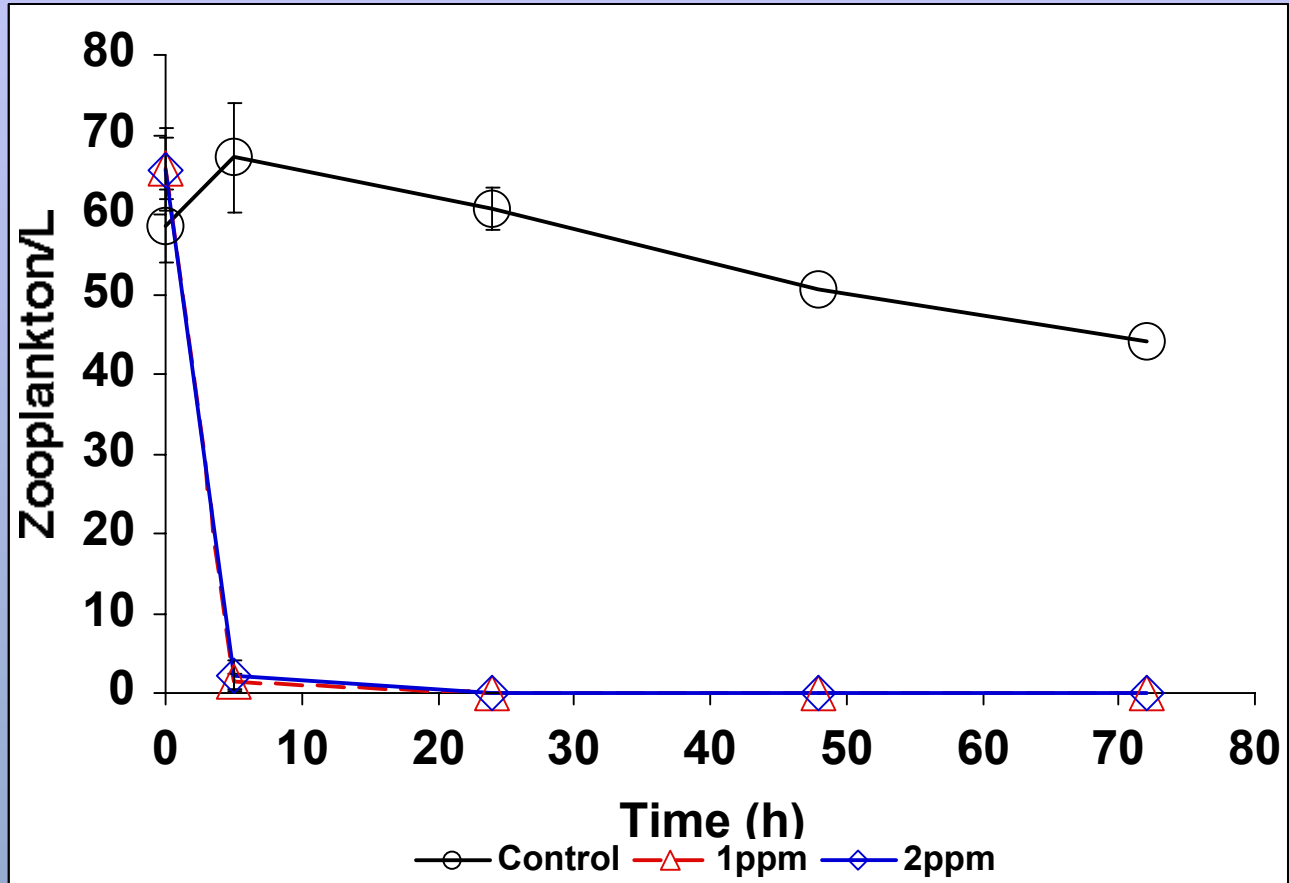


Sampling Mesocosms



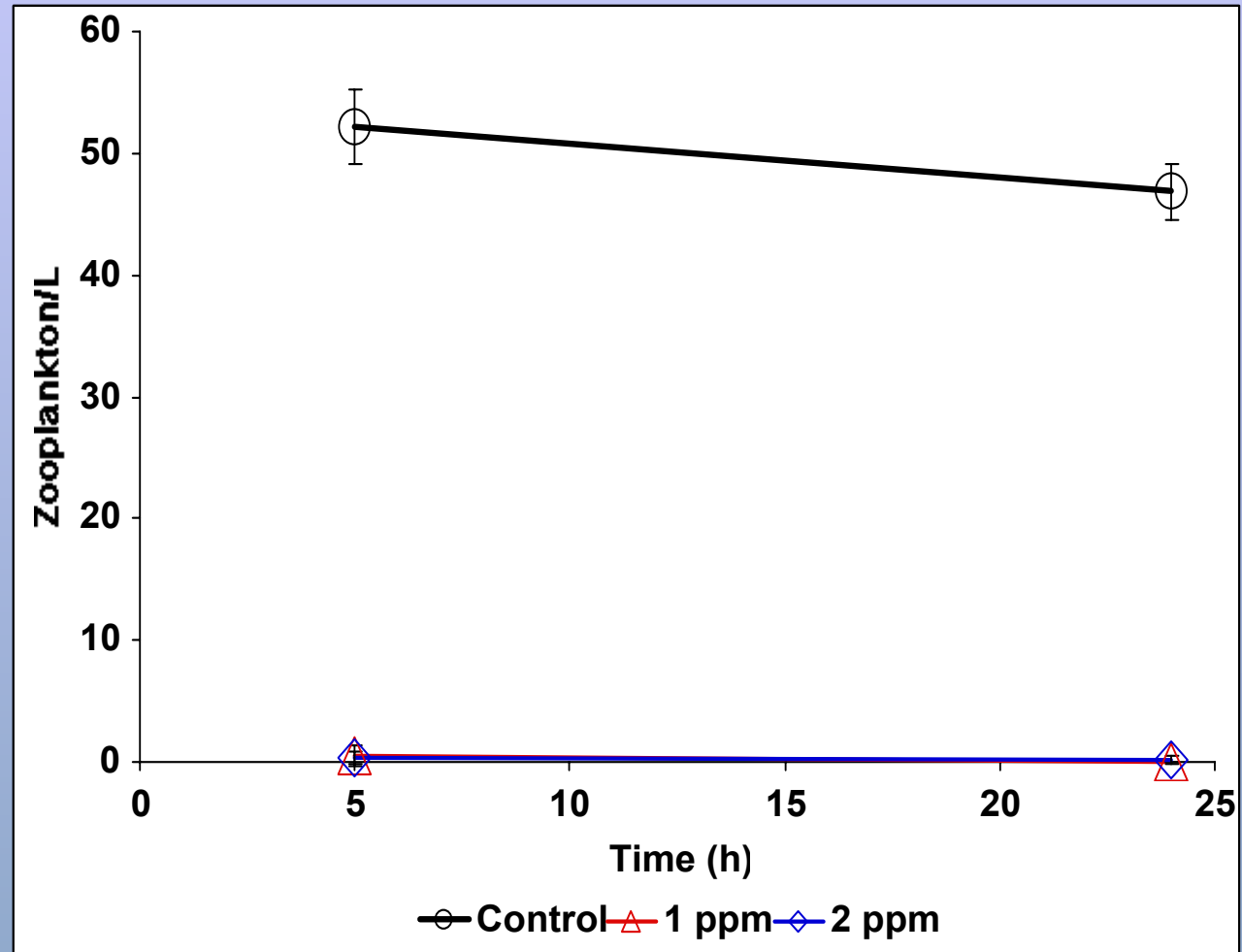
Zooplankton

Live zooplankton
per liter of
SeaKleen® -
treated water
2 concentrations
of SeaKleen®
Rapid decline of
zooplankton

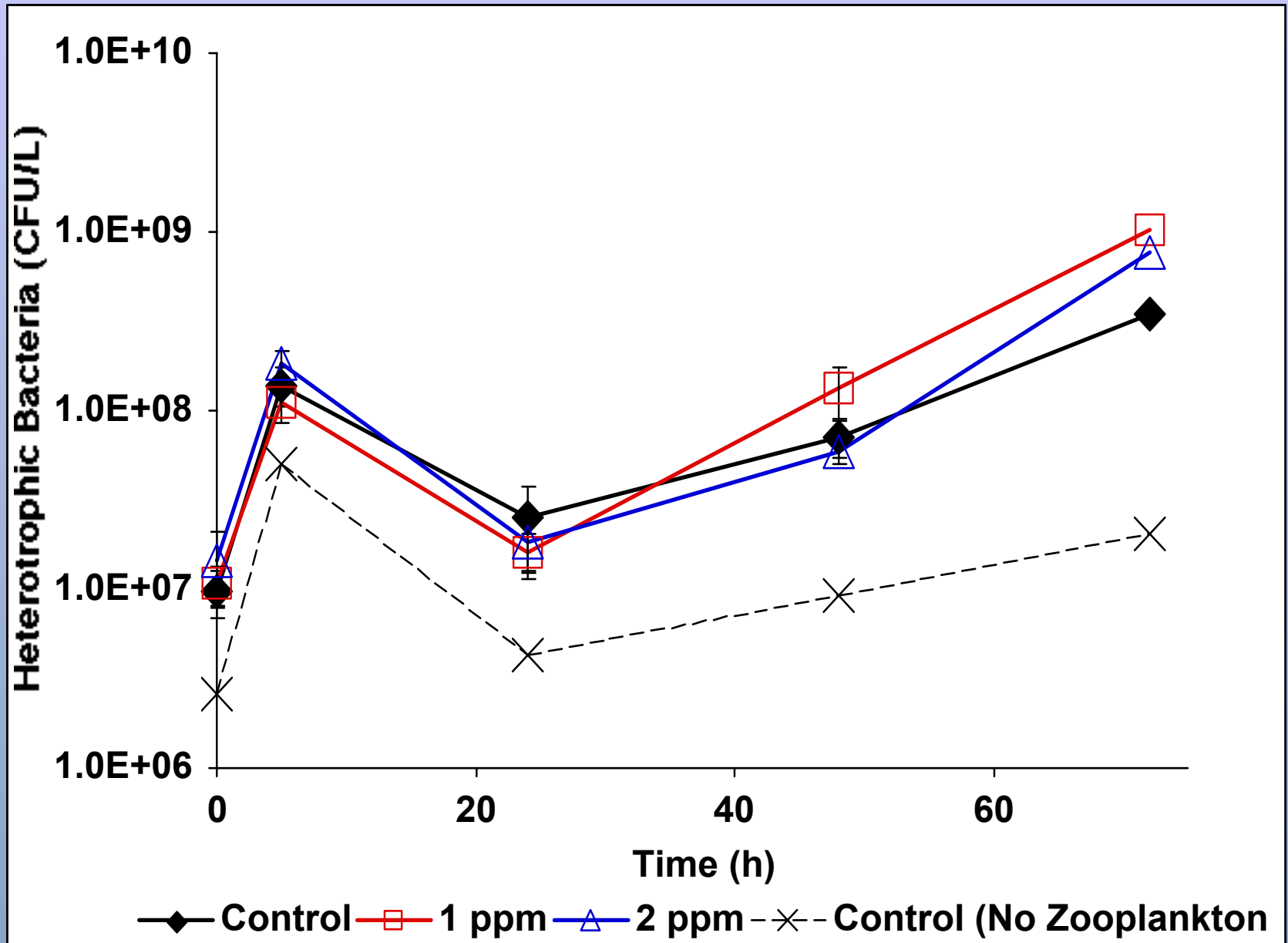


Zooplankton

Live zooplankton per liter in “re-stocked” 48 hour old SeaKleen® - treated water. Water was filtered (73 μm) before re-stocking. Zooplankton counted 5 and 24 hours after re-stocking. All added zooplankton showed mortality



Culturable Bacteria



Summary of December 2003 Results

SeaKleen® at 1 and 2 ppm

Zooplankton: nearly 100% kill

Bacteria: no apparent decline

Phytoplankton: awaiting results of
chlorophyll *a* analysis

48 hour old SeaKleen® treated water

Zooplankton: nearly 100% kill

Plans for Laboratory Experiments

“Microcosm” Experiments

3 liters of Puget Sound water held in 1 gallon jars

SeaKleen®: 0.1 to 1 ppm concentrations to find threshold concentration

Temperatures: 8 and 12°C

Zooplankton from Puget Sound

SeaKleen®-treated water “re-spiked” with Puget Sound zooplankton at 48 and 96 hours

Shipboard Experiment with SeaKleen®

Groton

Integrated Tanker Barge (ITB)

Built: 1982

United States Shipping LLC

Edison, NJ

Company operates 6 ITB vessels

Size: 48,000 DWT

Ballast water: San Francisco Bay

Sample treated and control ballast tanks
during voyage to Puget Sound



Photos from U.S. Shipping web site

UW Experience with Shipboard Sampling and Tests

S/T Tonsina **Alaska Tanker Company, LLC**



Double-hull tanker

869 feet long x 136 feet beam

Cargo capacity 807,000 bbls

- 12 cargo tanks (~2,800,000 gallons/tank)

Ballast capacity 269,520 bbls

- 12 ballast tanks (~850,000 gallons/tank)





***S/T Tonsina*: double-hulled,
double-bottomed**





Sampling microbiology and ballast water chemistry with Niskin bottle.





Sampling zooplankton with vertical plankton tow





Observing zooplankton under a microscope



Nissa Ferm deciding “live, dead, or moribund.”

Plans for SeaKleen® Shipboard Experiment

Ship: *Groton*

“Paired ballast tanks”

Treated ballast tank and control ballast tank

Collect water at 2 - 3 depths in tank

Microbiology, chemistry

Collect zooplankton with net (vertical tow)

Integrated sample from bottom to top

Samples

Zooplankton: determination of
live/dead/moribund after collection

Bacteria: determination of culturable cells

Phytoplankton: chlorophyll *a* analysis

“Living biomass”: measure ATP

Toxicity assay: method to be decided

Collection times: after tank is filled; 1, 2
days following; before discharge

Other Possible Research Activities

Biodegradation and fate of SeaKleen®

- Microbial mineralization and degradation

- Characterization of microorganisms that degrade SeaKleen®

- Temperature and light effects on degradation

Rapid toxicity bioassay

- Lumitox® - bioluminescent marine dinoflagellate (*Pyrocystis lunula*)

Rapid analytical method



G. Jensen



G. Jensen



foto: IZOR



J. Cordell